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CANDIDATE APPLICATIONS ANALYSES FOR THE
ARMY RESEARCH INSTITUTE/NATIONAL TRAINING CENTER DATA BASE

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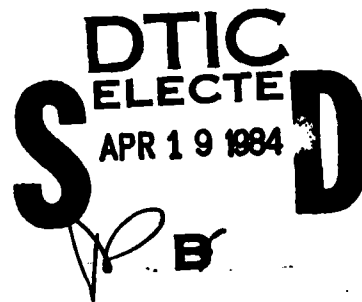
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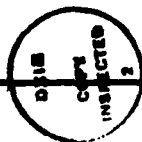
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Potential analyses of the ARI/NTC data are discussed under two major categories : Using only the NTC data, and, linking the NTC data with other data sources. Analytic studies, using only the ARI/NTC data base, are described using three approaches: component analyses, comparative analyses of battalions, and Combat Readiness Evaluation and Prediction. Major analytic studies are described for linking the NTC data with other data sources. These studies are described in relation to training, organizational policy, and personnel. Examples are presented of the kinds of linkage that could be performed to include potential outcomes and implications. Examples include the possibility of employing the NTC data as criteria for evaluating major change in Home Station training or personnel policy. The report discusses the feasibility of undertaking studies to examine the impact of NTC on combat preparation training within units. The potential value of ARI/POM conducting secondary analyses of the NTC combat engagement data is discussed. The data are unique and can provide important information to a variety of Army users in addition to ARI. The report describes potential uses of the ARI/NTC data base and identifies candidate applications of these analytic efforts. Major implications of these analyses are identified in the areas of training, doctrine, personnel and resource management, and human factors research and development. Potential users of the findings of these analyses are identified to include Department of the Army, TRADOC, FORSCOM, and the human factors R&D community. The information can assist ARI in the development of plans to employ the NTC Data Base, in undertaking secondary analyses and in supplying Army Commands with information which will assist them in combat and training developments.

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EXECUTIVE SUMMARY

Candidate Applications Analyses for the Army Research Institute National Training Center Data Base

Requirement:

The project requirement was a report which describes potential uses of the ARI/NTC data base and identifies candidate applications of the analyses efforts.

Procedure:

The ARI effort to collect, record, and process NTC data was described by reviewing documents and interviewing key ARI individuals involved in the current effort.

Proposed NTC data analyses and the resultant findings were developed and presented via a briefing to ARI personnel including the Commander and Technical Director. Based upon the briefing, interaction and recommendations, this final report was prepared for the Commander, ARI.

Findings:

The high fidelity combat simulation and the automated data base present at NTC provide a great potential for conducting significant secondary offline analyses.

The NTC data base presently available to ARI does not permit significant off-line analyses. Such analyses can be undertaken when the ARI/POM short term plan for establishment of a data base is realized. The plan is to establish a data base which permits integrating the four data sources to provide a full description of each of the mission conditions and includes cross-referencing the data sources. This will permit reconstructing a specific "battle" engagement.

Potential analyses of the ARI/NTC data are discussed under two major categories: Using only the NTC data, and, linking the NTC data with other data sources.

Analytic studies, using only the ARI/NTC data base, are described using three approaches: component analyses, comparative analyses of battalions, and Combat Readiness Evaluation and Prediction.

The component analyses permit interrogating the data on a wide array of issues as to how Battallions generally operate or perform. The output would be descriptive information on how doctrine is being adhered to, how various functions are being performed and how various levels within the task force interact.

The comparative analyses of battalions compare the simulated combat performance of battalions which undertook the same mission engagements. The analyses addresses differences among battalions on these combat performance indicators. If battalions do, in fact, differ are the differences consistent and is it possible to isolate factors which differentiate between high and low performing battalions?

The Combat Readiness Evaluation and Prediction approach focuses on the evaluation of unit performance. These analyses will determine if it is possible to predict or estimate "combat performance" based upon characteristics or performances exhibited by battalions at NTC.

Major analytic studies are described for linking the NTC data with other data sources. These studies are described in relation to training, organizational policy, and personnel. Examples are presented of the kinds of linkage that could be performed to include potential outcomes and implications. Examples include the possibility of employing the NTC data as criteria for evaluating major change in Home Station training or personnel policy. The report discusses the feasibility of undertaking studies to examine the impact of NTC on combat preparation training within units.

NTC (NATIONAL TRAINING CENTER)

Use of Findings:

The potential value of ARI/POM conducting secondary analyses of the NTC combat engagement data is discussed. The data are unique and can provide important information to a variety of Army users in addition to ARI.

The report describes potential uses of the ARI/NTC data base and identifies candidate applications of these analytic efforts. Major implications of these analyses are identified in the areas of training, doctrine, personnel and resource management, and human factors research and development.

Potential users of the findings of these analyses are identified to include Department of the Army, TRADOC, FORSCOM, and the human factors R&D community.

The information can assist ARI in the development of plans to employ the NTC Data Base, in undertaking secondary analyses and in supplying Army Commands with information which will assist them in combat and training developments.

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INTRODUCTION

BACKGROUND

This paper provides an approach for using National Training Center (NTC) data to formulate and resolve research and development issues for major Army users. This effort focuses on Army Research Institute (ARI) uses of NTC data in support of the Unit Training R&D Center at the Presidio of Monterey, Ca. The review and approach in this paper also has application to other R&D agencies.

The NTC is designed to be the most advanced combat training device available to the Army. An instrumented battlefield combined with MILES equipment allows dynamic two-sided free-play battles which are recorded for later analysis. Army battalions are scheduled to be rotated through the NTC approximately every 18 months to train, to undergo assessment and to receive detailed after-action reports. Since the actions of both the tested battalions and the OPFOR are recorded by the NTC computer, a considerable amount of data will accumulate. These computerized data can be replayed permitting a variety of secondary analysis and simulations that have never before been possible.

Many of our defense policies, tactics and methods are predicated upon archival data and "best estimates." NTC data, although simulation, provide a better opportunity for empirical analysis than has ever existed before.

According to AR350-50 (Training: National Training Center, March 1980), the secondary objective of the NTC is to:

Gather information to help improve doctrine, tactics, training systems, equipment, and procedures. This information also assists the Army in relating resources to readiness.

An extensive data base and data base management system is being developed under the auspices of ARI at the Presidio of Monterey, California. This data base will provide a rich source of data that can be used for secondary analysis to

formulate and resolve research issues without interfering with the primary training mission of the NTC. The data base architecture will provide enough flexibility so that the data elements may be arrayed a number of ways to serve a variety of users and needs.

OBJECTIVE

The objective of this effort is to produce a report which describes potential uses of the ARI NTC data base and identifies candidate applications of the analysis efforts conducted in the Unit Training R&D Center at the Presidio of Monterey.

CANDIDATE APPLICATIONS ANALYSES

There are two major types of secondary analytic studies that can be undertaken with the NTC data:

- I. Using only the NTC data
- II. Linking the NTC data with other data sources.

Analyses using only the NTC data permit determining "what is" or the present state of battalion simulated combat performance. Further such analyses can serve as a baseline reference on which to reflect or gauge the impact of major interventions by analyzing performance over time.

Linking the NTC data with other data sources provides the opportunity for specifying, tracking and assessing interventions. For example, the impact of organizational personnel and training policy can be assessed to some degree at NTC.

USING ONLY THE NTC DATA

General

While at NTC, battalions are required to plan and execute a large number (10) of defensive and offensive tactical missions. Not all units perform the same missions, but even when they do perform the same mission it is not necessarily identical in all respects. Therefore, the initial level of analyses of the NTC data must be at a macro level. The most important first question is: do the data permit differentiation, i.e., is there sufficient variance to warrant further analysis?

Once this fundamental measurement question has been affirmed, questions can be asked as to: what are the differences, and are they significant?

The NTC data allow for the study of process and of mission accomplishment or outcome.

The accumulated NTC Data permits the following large analytic studies:

1. Component Analysis
2. Comparative Analysis of battalions
3. Combat Readiness Evaluation and Prediction.

These analytic studies differ in approach and methodology.

- Component analysis involves descriptive analysis on isolated components.
- Comparative analysis involves normative ranking, criterion-referenced comparison and factor determination.
- Combat Readiness Evaluation and Prediction involves estimation to a criterion and part-whole variance analyses.

These three types of studies are discussed in the following paragraphs.

Component Analysis

Component analyses are descriptive analyses using the accumulated data of various battalions performing the same tactical mission, e.g. Reconnaissance in Force, Defend Battle Position (Day, Night), Movement to Contact. The following types of analysis can be conducted:

- Cross-sectional analysis at various organizational levels can be performed. A particular weapon use can be examined, e.g., TOW, Dragon.
- Analysis of unit actions (e.g., control) can be undertaken, e.g., gathering, processing, and employment of intelligence information;

employment of EW and NBC counter measures; communications; and security practices.

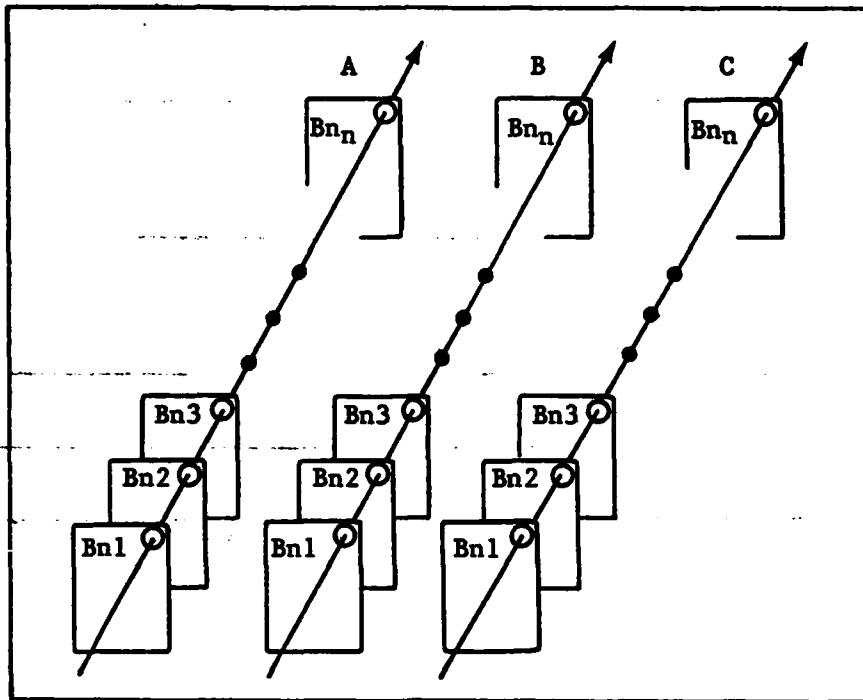
Figure 1 provides an illustration of component analyses. Analysis "A" involves examination of a weapon, TOW or Gunnery. The analysis could be limited to a single question of how the TOW was used in overwatch or at a more macro level, Gunnery Performance. Analysis "B" depicts an analysis of communication procedures. This analysis might involve communication links at a particular unit level (e.g., company) or between levels (TF, Company, Platoon). Analysis "C" alludes to examination of Security practices and could be limited to specifics (GSRs) or could deal with all aspects of security.

The outcome of a component analysis will be a detailed description of a component of the operations of NTC battalions. This analysis will answer research questions such as: Is there a general lack in following doctrine? Is gunnery performance fairly stable and satisfactory, or is there great variability?

The emphasis of the analysis would be to concentrate on one aspect of battalion operation to obtain information on the strengths, weaknesses, or inconsistencies across battalions. The output of these analyses would be descriptive information on how doctrine is being adhered to, how various functions are being performed and how various levels within the Task Force interact.

The information would serve to provide a description of the present state of operations and activities. The output should have relevance in the areas of doctrine, training, and resource management. This approach will identify cases where doctrine is or is not being adhered to and what the deviations are. Areas that require greater training emphasis would be delineated. Also, information pertinent to resource management decisions would be provided, e.g., gunnery performance.

In addition, these analyses could serve as a base-line for evaluating the impact of major change which is introduced to improve adherence to doctrine, and to improve performance.



A = TOW OR GUNNERY

B = COMMUNICATIONS

C = SECURITY PRACTICE

FIGURE 1: COMPONENT ANALYSES

Comparative Analysis of Battalions

Comparative analyses of battalions would compare the performance of battalions as they perform the same missions. The objective is to determine how and in what way battalions differ. The emphasis in these analyses is on comparative combat readiness of battalions as judged by their "combat performance." These comparative analyses are illustrated in Figure 2.

The initial analysis would involve ranking battalions on the basis of combat performance indicators. The data from the engagement simulation and the live

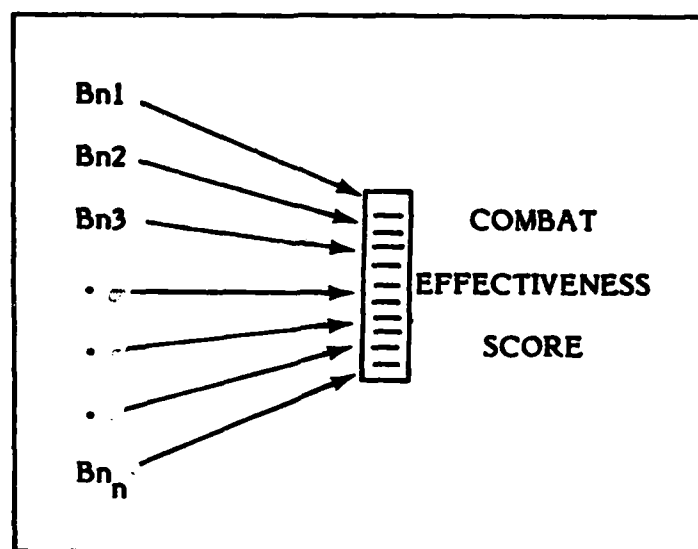


FIGURE 2: COMPARITIVE ANALYSES

fire exercises would serve as the criteria, or combat effectiveness e.g., equipment-loss ratios, rounds-fired-to-kill ratio, etc.

The relative ranking of battalions on each engagement exercise would be obtained. The ranking of battalions across engagement exercises would also be examined. The questions to be answered are: First, do battalions differ in their performance on a mission? Can they be ordered as to combat effectiveness as judged by NTC criteria? If the answer to the first question is yes, then the second question is: Are there battalions which are generally high performers and battalions which are generally low performers?

Figure 3 portrays three different possible outcomes of comparative performance of seven battalions scored on a particular engagement (Mission A) exercise. In the first two instances, battalions scored about the same, all low or all high. The third instance, shows that battalions varied markedly in the combat effectiveness score they obtained.

An implication of battalions performing at the same level is that the Army is developing a fairly standardized battalion in terms of combat readiness. Examination of the combat performance indicators would provide information to judge the level of combat readiness being produced. Of course, the selection and adequacy of the criteria would be extremely important for deciding in either of the above situations.

If battalions did vary in their combat readiness as judged by these criteria, then at a minimum the implication is that a relative, standardized battalion is not now being produced. However, if battalions could be ranked by performance and they maintained their relative ranking across combat engagements, then there would be a basis for more detailed analysis.

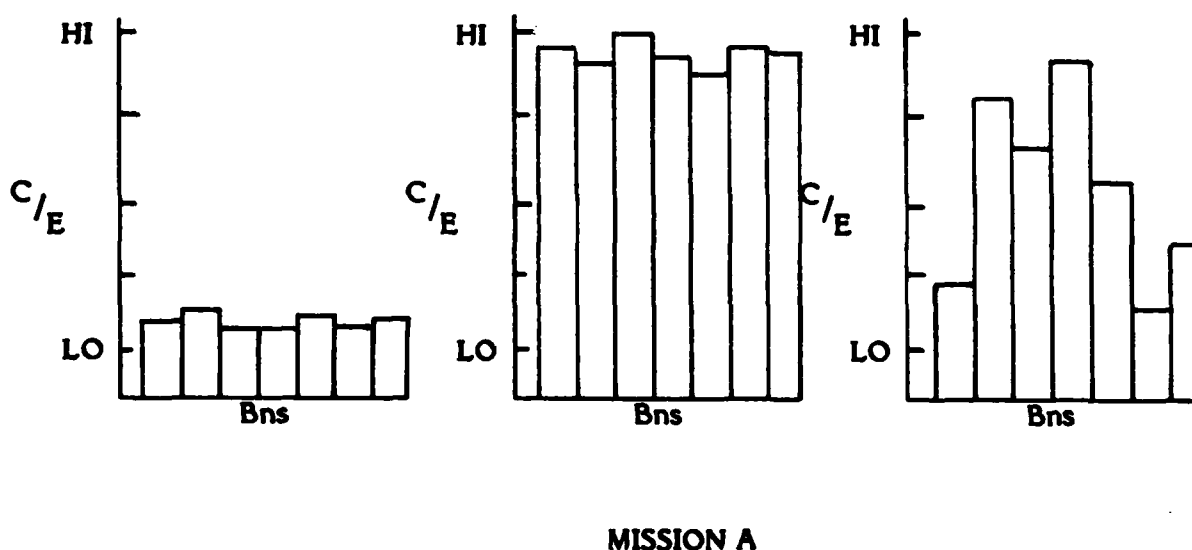


FIGURE 3: ALTERNATIVE OUTCOME OF BATTALION COMPARATIVE ANALYSES

These potential outcomes are portrayed in Figure 4 which depicts the number of times a battalion received a low, medium, or high combat effectiveness ranking. All battalions had undergone the same ten engagement exercises, (missions). As shown, battalions varied in their performance, with some battalions performing always low (Bn2) and others performing High (last two Bns).

C/E RANKING

		L O W	M E D	H I G H
	1	5	3	2
	2	10	0	0
Bn	3	2	4	4
	4	1	4	5

	.	0	0	10
	n	0	3	7

FIGURE 4: FREQUENCY OF RANKING ON TEN MISSIONS, ACROSS MISSIONS

What factors or cluster of factors might account for these consistent differences in the performance of battalions? By grouping high-performing battalions and low performing battalions, further analysis of their performance at NTC could be done to search for common factors within each group and differentiating factors between groups. Process analysis of sub-groups could be undertaken to attempt to isolate major differentiating factors, e.g., planning, control, communication, general adherence to doctrine, etc. Such an outcome is presented in Figure 5, where factors A, F, and n are predominant in low scoring battalions while factors B, D, and E are predominant in high scoring battalions. As shown, Factor C is common to all battalions regardless of the combat effectiveness (C/E) score and is, therefore, not useful in distinguishing low performances from high performing battalions.

If such factors were isolated, then cross-validation studies with other battalions could be undertaken. The result would be clustering or identification of differentiating factors (e.g., general organizational competence, planning, communication, use of resources). Further audit of the history and prior experiences of the high and low performing battalions would be required to determine if precursor factors can be identified.

The output of this comparative analysis would provide information on the combat readiness of maneuver battalions to include information on standardization and relative level of combat readiness. Conceivably, factors associated with high and low performance could be isolated. Such factors would provide profound implications for resource allocation, training, and performance evaluation.

Combat Readiness Evaluation and Prediction

This analysis would focus on the evaluation of unit performance. A key assumption is that battalions differ in their performance and these differences extend across a variety of activities. These analyses are an extension of the analyses outlined in the previous section.

If analysis of NTC data elements permits isolation of factors associated with good and poor performance as shown in Figure 5, then analysis can be initiated to determine the extent the components contribute. An important question is, can one predict or estimate combat performance based upon characteristics or performances exhibited by battalions at NTC? The analysis would address determination of the relative contribution of components and would eventually lead to estimating combat readiness as judged by the NTC criteria.

FACTOR	C/E SCORE		
	LOW	MED	HIGH
A	X	O	O
B	O	O	X
C	X	X	X
D	O	X	X
E	O	O	X
F	X	X	O
.	.	.	.
.	.	.	.
n	X	O	O

FIGURE 5: FACTOR AND PERFORMANCE LEVEL PROFILE

The factors and their relative weights or variance contribution to estimating total performance score would be determined to provide an empirical model such as $\text{Performance} = f(-xA+yB+lC+jD-kF. . . rN)$. The factors would be selected through the previous component analyses.

More explanatory models of performance are also possible. For example, Olmstead et.al. (1978)¹ have found organizational competence to be a major determinant of organizational effectiveness. These researchers isolated seven organizational processes which are identified with three components which make up organizational competence. The three components are:

1. Reality Testing. Capacity to assess the reality of situations facing the organization - the ability of the organization to search out, accurately perceive, and correctly interpret the properties and characteristics of its environments (both external and internal), particularly those properties that have relevance for the objectives and survival of the organization.
2. Adaptability. The capacity of the organization to solve problems arising from changing environmental demands and to act with effective flexibility in response to these changing demands.
3. Integration. The maintenance of structure and internal function under change and stress, and a state of relations among sub-units that insures that coordination is maintained and sub-units do not work at cross purposes.

Seven processes have been designated to permit measurement of the components. Each of these organizational processes was conceived to be related to one of the components of Competence. The relationships are as follows:

¹ Olmstead, J.A., Baranick, M.J., and Elder, B.L. Research on Training for Brigade Command Groups: Factors Contributing to Unit Combat Readiness. Technical Report No. FR-ED(C)-78-1, Alexandria, Virginia: Human Resources Research Organization, February, 1978.

Competence Component

Organizational Process

Reality Testing

Sensing
Communicating Information
Feedback

Adaptability

Decision-Making
Communicating Implementation
Coping Actions

Integration

Stabilizing

Thus, each component of Competence is comprised of one or more organizational processes that can be measured and whose quality can be evaluated. These processes would allow an analysis of performance according to a model such as $NTC\ score = f(Organizational\ Competence)$ where $Organization\ Competence = f(Reality\ Testing, Adaptability, Integration)$.

If this model was employed, the initial approach would be to attempt to identify these processes with the NTC battalion data elements. For example, information related to sensing might be obtained from examination of the battalions' intelligence activities. Also, communicating implementation might be determined by examining oral and written communications by a battalion.

If these analyses supported the view that the quality of process performance (competence), relates to NTC performance, then a significant gain in evaluation of combat readiness would have been achieved. A further step would be made in isolating the critical elements leading to excellence of performance - the critical elements of excellence.

Further there would be marked implications as to the nature and type of training of battalion staffs prior to their attending NTC. Also, the impact on ARTEP testing and performance evaluation would be considerable.

LINKING THE NTC DATA WITH OTHER DATA SOURCES

General

The ability to link the NTC data with other data sources will provide the Army the maximum information and research capability. To a great extent the value of this linkage will depend upon the ability to carry out the analyses described in the previous section which use only the NTC data.

The advantage of using only the NTC data is that the analysis can be done offline and not require data from or coordination with other organizations. The disadvantage is that the power of linking other (non-NTC) essential information is lost.

The NTC data, in these linkage studies, will serve primarily as criteria. NTC experience represents the final link in the training and experience of the battalion. In addition, it represents the most advanced combat-simulated training combined with instrumented, objective data currently available.

Feedback from NTC to each participating battalion now occurs through "Take Home Packages" on training strengths, deficiencies and suggested actions for improvement. The ability to undertake secondary analysis of the NTC data, as described previously, will permit providing information on performance of battalions across the Army, i.e., how combat ready they are and factors related to combat performance such as adherence to doctrine. Obviously, the performances and actions observed at NTC are dependent upon what happened at the home station, the institution (school), and the quality and quantity of the personnel and resources provided.

By observing NTC performance across battalions, and determining limitations in performance or erroneous performance, action can be initiated to rectify those problems. In a sense, an audit could be undertaken to isolate prior actions or conditions which could account for the observed outcomes.

For example, personnel turbulence or lack of opportunity to do collective training because of limited facilities might be associated with battalions that performed poorly. The action implications of personnel stabilization, or resource management to improve training facilities and training opportunity both might be correct though different. Without the opportunity to link back, this type of information would be lost and the appropriate action might not be known.

Clearly, the initiation of action or change must be specified to permit determining the present condition and the impact of the action at a later point on NTC performance. The introduction of these linkage studies permits the opportunity for initiating empirical changes and monitoring these changes prior to the battalion going to NTC where no such intervention would be permitted. (Some changes are required to permit collection of certain data, which are not currently collected e.g. identification of individuals by Social Security number within units and within position while at NTC.)

Figure 6 shows three major analytic type studies which can be undertaken by linking NTC data to other data sources:

- Training
- Organizational Policy
- Personnel

Training

Training would include individual and collective training, both institutional and within the unit. Training would encompass content, training approach, evaluation, and management of training.

The emphasis of the studies would be on collective training and performance evaluation. Simulation training and performance evaluation would be a major source of study, e.g., tank crew simulation training, combat battalion simulation exercises.

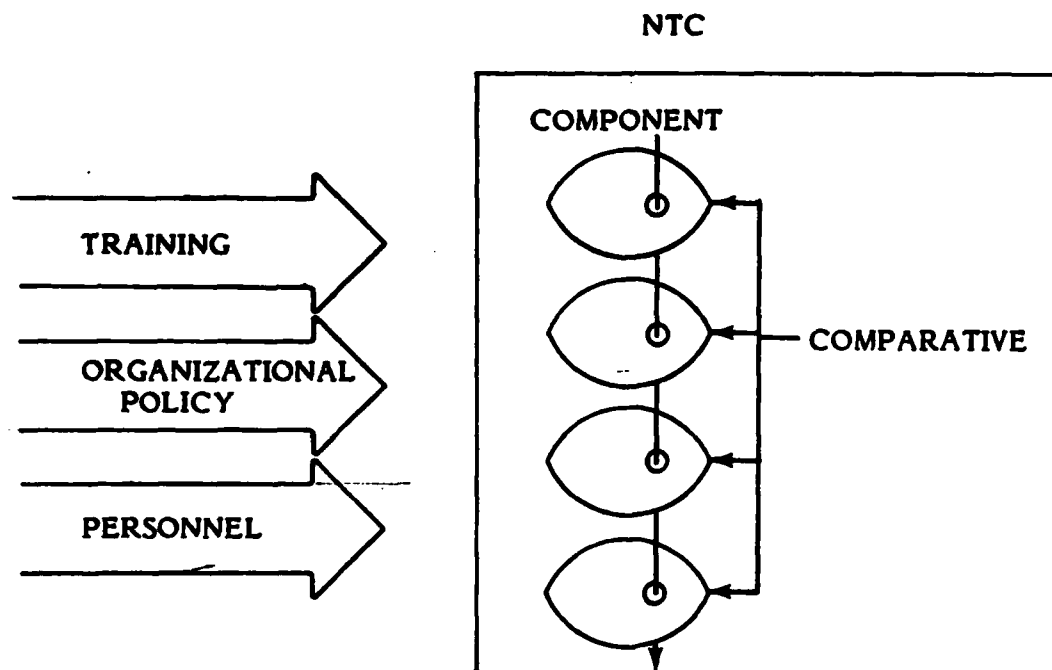


FIGURE 6: LINKING NTC DATA WITH OTHER SOURCES

Based upon the feedback from NTC, an assessment could be made as to the adequacy of the present Home Station Training for preparing for NTC. What type of training is most important at the crew, platoon, company, and task force level? Should crews be especially trained on use of terrain and movement? Should the company emphasize different types of communication procedures and uses of security? In maneuvering, should more training and practice be given on developing mutual support between CO/TMs and Platoons? Is Gunnery and employment of weapons an area that needs special attention? Should special emphasis be given to the use of TOWs in an overwatch role?

At a higher level, should the battalion Task Force undergo special FTX or battle simulation training such as CATTs or ARTBAS in preparation for NTC training?

What type of collective training and ARTEPS employing MILES would be the best preparation? Should sleep discipline training be given prior to undergoing the extended continuous training at the NTC?

In summary, how does the anticipated NTC experience impact on training needs, resources, plans, and activities? An analysis of the NTC missions could provide a crosswalk with ARTEP missions and battle simulation training. Procedures employed for combat performance measurement at NTC could be adapted or adopted for home station training. Re-emphasis on correct use of doctrine would possibly be required.

Organization-Policy

The linkage of NTC analysis would be at the level of resource management, both personnel and material. The impact of the new manning system to provide for stabilization, and increased cohesion, on NTC performance could be investigated.

The impact of conducting NTC combat preparation training on meeting other mission requirements and on use of limited resources could be determined. This major combat preparation training which involves a brigade and demands extensive preparation has to have a major resource cost and impact. If battalions are going to be successful at NTC, then what are the associated costs in material, time, personnel, ammunition, etc? What is the impact on support in service units, such as supply or medical units which need to receive integrated training with combat elements?

Once cost and impact implications are captured, then policy of the use of NTC might be re-examined. Of special significance would be policy regarding the selection of units for training at NTC and the frequency of such training.

Post-NTC training and evaluation emphasizes, via the Take Home Package, actions that returning battalions can employ for determining short and long range training plans. If another brigade is slated to prepare for NTC, then what impact does that have on the returning battalions? If returning battalions are

not able to initiate training or if their experience at NTC was one of more perceived failure than success, what, if any, impact does this have on morale or retention of personnel?

In short, the impact of Pre-and Post-NTC could be investigated. Such an analysis might permit greater specification of associated costs as well as benefits.

Personnel

The factors associated with NTC in this area are primarily associated with manning the force and are of interest to DCSPER and TRADOC. To what extent does the quality and quantity of NCOs within battalions contribute to performance at NTC? Is it possible to relate officer's experience, education and specialized training to performance at NTC?

The quality of the enlisted force in the combat arms and the relationship of quality to NTC performance could be investigated. The "Gideon" type study would be possible. By statistical sorting, identification can be made of tank crews or TOW operators who vary in aptitude or educational backgrounds. Do higher-aptitude Tank Commanders perform better than low-aptitude Tank Commanders in live fire or engagement simulation exercises? Tying the NTC data with the Defense Manpower Data Center (DMDC) data base and Home station training would permit a unique, longitudinal study relating quality of force acquisition and combat performance.

ANTICIPATED USERS OF THESE ANALYSES

The major implications of these analyses would be for the areas of training, doctrine, personnel and resource management, and human factors research and development.

Major Army agencies, in addition to ARI, that would be users of the findings are:

- DA - DCSOPS
 - DCSPER
- TRADOC - DCSCD
 - DCST
- FORSCOM - DCSOPS
 - DCSPER

Within the TRADOC schools, the Combat Development Directorate and the Training Doctrine Directorate would be the major users.

The human factors research community, across DOD and in the civilian sector would be users of the major methodologies employed and the general outcomes of these analyses.

EXAMPLES OF USE OF NTC/ARI DATA BASE WITH IMPLICATIONS

NTC provides a unique opportunity during peace time for obtaining information on the impact a series of major Army changes can have on combat performance. The NTC provides an important test bed for checking out the soundness of the doctrine developed for the "Airland Battle" as well as the consequences of introduced modifications. The NTC data base can provide information on the impact of the new personnel manning system on "combat performance." The opportunity exists to employ the NTC data to provide information on the implications different personnel selection criteria and ability mixes might have on combat performance. By obtaining baseline data, the NTC data can be used to evaluate changes associated with the introduction of new weapon systems such as the Bradley and the M-1 tank.

In addition to providing information pertinent to the above topics, the NTC data base permits generating information on the present "combat performance" capability of maneuver battalions to undertake various missions. Using the existing NTC data along with other available data sources allows for determining the implications other factors have on combat readiness.

The NTC data provides key information on the research issues of how to measure combat readiness, how to estimate combat readiness, and what factors might be associated with improvement of combat performance.

EXAMPLES

The following examples and discussion are provided to indicate the potential the ARI/NTC Data Base has for addressing important Army issues. The examples are of two types: Unit NTC Performance and Combat Performance.

UNIT NTC PERFORMANCE

The unit NTC performance analyses use only the NTC data and are concerned with generating information on performance of units who have gone through

NTC. The analyses would permit comparing the performance of battalions, companies and platoons. The analyses would use engagement simulation and live fire data. Specifically, the analyses would use objective, automated data of position location, movement and firing data of hits, misses, kill ratios, etc. The result would be an objective measure to be employed for evaluating "combat performance."

The analyses permit answering the following questions:

1. Do units generally perform alike on the same mission?

If they do, then there is a standardized level of performance being produced. Clearly, the next question is, are there missions on which they are low and others on which they are high, or are they low or high on all missions? If there are differences, then a more detailed analysis would be required for those missions on which the performance was generally low. If it was found that units are generally low on all missions, then the determination would have to be made as to what actions and resources would be needed to increase the level of performance. Obviously, the ideal outcome would be units that all perform well.

2. Are there some units that consistently perform better than other units?

If the answer is yes, then a standardized output is not being achieved. One immediate implication could bear on "call-up" or assignment of units in time of mobilization. The battalion differences could be investigated by examining such factors as whether the unit is a COHORT unit and the quality and type of home station training preceding the NTC experience.

3. Do units show great variability on their performance of missions?

Such an outcome would indicate there is not a standardized output, and that likely there is little standardization in training. Conceivably, the outcome would show some units perform better than others on particular missions and worse on other missions. If so, then one would investigate whether such differences were a result of training emphasis, training resources, opportunities for training, etc.

The unit measures developed would serve as a baseline for comparing the impact of changes. Also, unit performance measures would serve as a criterion for evaluating the contribution of other factors.

COMBAT PERFORMANCE

The combat performance analyses employ the NTC data as a criterion of "combat performance," and use other available data sources to provide additional insight as to antecedent conditions that account for performance level at NTC. Basic to these analyses is the condition that the unit performance measure has the fundamental measurement properties of variance and objectivity.

One analysis would involve obtaining information pertinent to the New Manning System. By obtaining information on how long cohort and non-cohort units scheduled to go to NTC have been formed and stabilized, a comparison on relative NTC performance is possible. Ideally, a variation in time in unit stabilization would be possible to allow for obtaining trend data. One possible outcome would be to provide information on how long a unit needs to be together before an impact on "combat performance" is detected. Also, information on whether this major policy change shows in NTC performance would be available.

A second analysis employing available data is to investigate the power of existing measures of Army performance to predict NTC performance. Individual SQT scores represent distant but perhaps related Army performance measures which are available for estimating NTC performance. Such an analysis could

involve conducting analyses at platoon, company level and battalion level. MOS SQT score profile at the unit level would be used for the analysis. At a more global level, ARTEP evaluations would be obtained and used as a basis for prediction and comparative evaluation of units. The relation between Unit Readiness Reports and performance at NTC would also provide useful information. The output is to determine how early and how well existing measures correlate with or permit estimation of NTC performance. If a strong enough relationship could be developed, then information would be available as to when it would be most advantageous to send a unit to NTC. In developing such a measure, or profile, more information on unit training status would likely be needed in addition to the Training Required estimate of the commander.

A third analysis would address the ability to predict NTC performance based upon entry level ASVAB scores. A congressional requirement is to validate the relationship between entry level aptitude criteria and job performance. In addition, this type study would permit obtaining the relationship between ASVAB/AFQT and performance at NTC, thus providing information on classification criteria and job performance. Information of this type can provide insights as to future requirements of quality of personnel, especially with the planned introduction of new weapon systems.

NEXT STEP

This report has identified and outlined several research and development issues for which the NTC data are suitable and the users for whom these studies would be useful. The next logical step in using the NTC data base fully would be to fit the NTC R&D products into an overall management strategy. That is, what are the management and informational needs of, e.g., TRADOC management for training and combat doctrine development, and where do the NTC informational products address those needs?

This analysis would be accomplished by identifying the functional responsibilities of key decision makers and action officers within the organization of interest, e.g., the combined Arms Center (CAC). The Commander, CAC has responsibility for NTC and CGSC as well as combined arms doctrine development. He has numerous staff and action officers who report to him each of whom have distinct functional and informational requirements. The analysis suggested would identify all of these requirements through review of documents such as Mission Area Analyses, Force Integration Plans, Organization and Function Manuals, etc. These requirements could then be organized into a system which would structure the data elements to fill these organizational requirements.

The organizational and functional needs analysis could also extend beyond CAC to the TRADOC schools, FORSCOM HQ, and DADCSOPs. The resulting management system would be engineered to provide appropriate planning, control, direction, organization and communication among the agencies involved and to insure that NTC findings and secondary analysis results are routinely received by the agencies and people who can incorporate them into ongoing action and programs.

APPENDIX

USE OF NTC DATA BASE: AN INTERIM REPORT TO ARI

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INTRODUCTION

The approach I have taken in this interim report is to express my observations, reactions, and opinions based upon my experience and the information provided to me by ARI.

POTENTIAL OF NTC DATA BASE

The extensive data base provided by NTC is the only source of repeated observations of fully instrumented battalion level combat field exercises under controlled conditions. This combat realistic NTC exercise represents the culmination of unit training and provides the opportunity for determination of the battle readiness of a unit in a "combat like" situation.

NTC is a high fidelity combat simulation, which employs highly technical and fully instrumented observations and provides a rich body of data for analysis. Information can be obtained about the impact on combat readiness of such diverse issues as quality of the force, new manning systems, training and doctrine. The use of the ARI/NTC data base is to a great extent dependent upon the nature and accessibility of the NTC data elements and the fidelity of the NTC simulation.

SECONDARY ANALYSIS CONSIDERATIONS

As directed, the research efforts associated with NTC are to be based on capturing available NTC data on a non interference basis. Present simulation and instrumentation are designed to assist NTC in carrying out its primary training and evaluation mission. Necessarily, the composition of the data base dictates to a considerable extent its utility for secondary analyses. Knowledge of the composition of the available data base will help researchers understand the limitations of the data. Its validity, reliability, and its fidelity will dictate the potential use of the data base.

POTENTIAL USES OF DATA BASE FOR OFFLINE ANALYSIS

Present Data Base

In my opinion the data available to ARI is not presently suitable for entering into an offline data base. Some of the issues are as follows:

Simulation

Necessarily the terrain and geography limit the extent to which one can generalize. The equipment on hand at NTC for both blue force and op force is limited in types and amounts. Not all players are instrumented and as such what impact these uninstrumented players have on a particular operation may go unknown. The state of simulation in telemetry is such that the simulated performance of weapons varies on a seasonal basis. The battlefield simulation is uneven. Indirect fire simulation is of much lower fidelity than is direct fire simulation. Close air support and air defense activities are not being played as realistically as would occur on an actual battlefield.

Data Quality

Four sources of data are available:

1. The digital or instrumented tapes provide positional location, fire, hits, misses, movement and kills. A major limitation of this data is that not all players are instrumented and the B units available with players become inoperative without being recorded. Data are not displayed at player level except for live fire. Otherwise the data are summed into units at the platoon level and above.

2. The voice tapes consists of forty channels of information. They require special, expensive equipment to permit playback. Presently these voice tapes are used over and over and as such are not now available for offline analysis.

3. The audio-video after action reviews which use information from several sources consist of about 30 hours per battalion since there are ten missions and it takes about three hours for every after action review. This information is prepared by the NTC staff for instructional purposes and understandably they edit pieces of the audio, digital, and video data together. Therefore, it is not representative of the full battle simulation.

4. The fourth data source, paper data, presently consists of the Take Home packages which are summaries and as such are not suitable for detailed offline analysis.

The secondary analyses questions that can be asked of the present data base are very limited and consists primarily of the take home packages. Present analysis is primarily methodological and is concerned with reliability, validity and discriminability. Since the four data sources are not now integrated, the ability to conduct secondary analysis is limited at this time.

Near Term Opportunities & Issues

The ARI/POM short term plan is to establish a data base which permits integrating the four data sources and providing a full description of each of the mission conditions and cross referencing the data sources. The objective is to permit integration of the data and provide full description of each mission with conditions. This permits reconstructing a particular battle. The information will be entered into a data base management system to permit offline analysis. Once this is accomplished, a series of secondary analysis questions can be addressed.

Secondary Analysis Questions:

- Longitudinal Studies of Battalions at NTC
- Compare adherence to doctrine and mission performance
- Comparison across Battalions on different tactical missions

- Comparison across Battalion on EW/NBC/Air Support, combat services support operations
- Determine unit combat effectiveness measures

Longer Range Opportunities & Issues

The long range plan is to obtain home station data pre and post NTC. This would require the full establishment of the BTMS now under development, and coordinating the home station training with the NTC data. If Social Security numbers were obtained for individuals scheduled to attend NTC and those individuals tracked at their home station and at NTC then additional significant answers to questions relevant to combat readiness could be pursued.

Some of the issues that could be addressed include, effect of personnel stabilization, quality of the force, impact of NTC on combat preparation, training within a Division (Pre/Post), assessment of the adequacy of home station training for NTC experience, determination of optimum, home station preparation of a unit prior to NTC training. Also, the impact of special preparation of Battalion Commanders and their staffs prior to NTC on such programs as CATTs or ARTBAS can be determined. The long range potential, if realized, provides an opportunity to integrate fully individual, and collective training within units with NTC combat readiness training.

SUMMARY COMMENTS AND OBSERVATIONS

In my opinion, significant off line analysis is not feasible with the currently available data base. A major factor is the inability to estimate the impact of the uninstrumented players in contributing to erroneous or lost data. Implementation of the ARI/POM short term plan (as discussed above) will provide the data enhancements necessary to conduct secondary analyses.

I believe that the following conditions must be met to understand the composition and the utility of a data base. There must be an awareness:

- of the battlefield situation
- of the fidelity of simulation
- extent and nature of instrumentation
- amount of data possibly lost or erroneous
- extent of pre-editing of the data

Awareness of these events and their influence on the data plus the ARI/POM near term plan will permit significant and impartial use of the NTC data for secondary analysis.